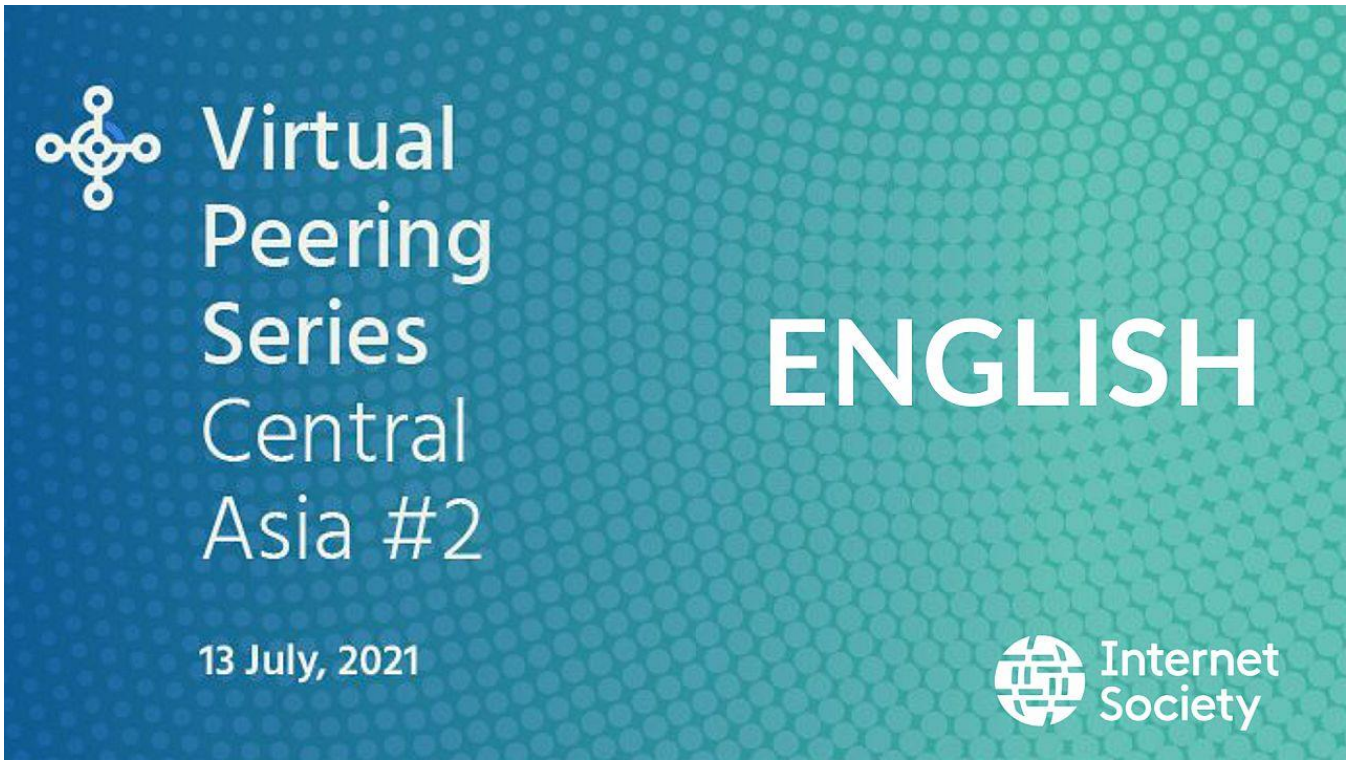

Virtual Peering Series – Central Asia #2
13 July 2021

Vahan Hovsepyan

Hi everyone, ladies and gentlemen, it's a real pleasure to welcome you to the second event in the Virtual Peering Series for Central Asia. And you're perfectly aware of the fact that the entire series was created by a bunch of people that I will introduce to you shortly. I am the External Relations Officer for Central Asia and Caucasus, RIPE NCC, and this series was organized jointly by ISOC, RIPE NCC and the Euro-IX to facilitate development of peering, and establishment of better relations amongst Central Asian states. This series will help our peers in Central Asia to deploy peering networks and IXPs, and we've been assisted by FLEXOPTICS, AMS-IX, Facebook, PCH, and, well, we're get more details on our sponsors later in the session. But I would like to ask everyone to be as active as possible, there will be a third event in the same series, which is slated for September. And the third event will probably be devoted to IXP regulations, and the legal framework. But today, there will be another great presentation to be delivered by PCH. And you will also have a chance to discuss a number of issues to be raised in the PCH's presentation for you to be able to better understand what needs to be done in Central Asia. Without further ado, let's move on according to the agenda,

Nishal Goburdhan
Hi everybody. My name is Nishal Goburdhan. I'm an Internet analyst and I work at Packet Clearing House, we're a nonprofit that's based in California, and we've been helping Internet exchange points develop across the world since about 1993. We're also involved in some DNS work. But this presentation is not about PCH, if you'd like to know what we do, you can contact me at the end, and I'll happily talk more about that.

I think this is a picture that we're all familiar with. It's source is caida.org, and it largely tries to describe what the Internet looks like. But practically, I don't know about you, if I look at this picture, it doesn't tell me a lot about the Internet, except that there's lots of lines interconnecting people. When we think about the Internet, as normal humans that are interacting with it, is usually something like this, where there's a certain tier of Internet networks that are connecting to each other. And those Internet networks usually work in a way that they have to perform, or buy transit from one another.

At its most basic level, the Internet is, as you know, probably typically a local Internet service provider, somebody that sells Internet access in your region. That Internet Service Provider typically connects to a larger Internet service provider, perhaps one that has got operations in multiple cities, or in multiple countries, but it's still typically limited to a region. That second tier service provider typically ends up buying IP transit from somebody that we call a first tier service provider, or a larger Internet service provider, a global Internet service provider. There are about 14 of these in the world today. The thing that's common about this really is one thing, that in order to get access to the Internet, if you're somewhere at the bottom of the chain, you've got to buy IP transit.

At the end of every month, at the end of every quarter, the end of every year, you've got to go to that Internet service provider that you have a contract with, you've got to give them money. And in exchange for you giving them money, sorry, they will connect you to the Internet. It's the model we were taught. It's the model that we grew up with. And it's the model that we know that works. And it's really the simplest way that we know of running the Internet.

What started happening about 25 years ago was that the entire network started to realize that they could try to potentially save money, by not just passing on this kind of IP transit to networks that were higher up in the food chain. What if they started interconnecting to each other? And that's really what those purple lines are. Those purple lines are interconnections between the Internet service providers themselves at a lower tier, starting to understand that it was more efficient, and faster and cheaper. more importantly, if they could interconnect between

themselves. And this has happened over time, and this ultimately is the Internet as we know it, where you've got a neutral interconnection point, and I've depicted that as the white cloud in the middle. You've got the smaller tier ISPs all interconnecting into that, and they're peering by means of those purple clouds.

Now I have been using two words consistently, and I haven't yet defined them. And I always like to have a clear definition of what we're talking about, because I think that that's going to help all of us understand what we're trying to get to. And those two terms really are Internet transit and Internet peering. The simple concept that I'd like you to remember is that Internet transit is a relationship where you have a commercial commitment to pay somebody in exchange for them, giving you access to as many parts of the Internet as they can get you to.

Peering agreements are typically agreements that happen across usually Internet exchanges. And the fundamental difference that we want to bear in mind, peering agreements usually are settlement free. And that's a fancy way of saying that there's no money that goes across a peering agreement. So, you can read the full on definition later, obviously, the slides will be made available to you. But the essential difference that we care about is that transit costs money, and peering generally doesn't. It's not true that peering is free, let me just clear that up at the start, you obviously need to invest in your infrastructure. But we're talking about the nature of the relationship between the two parties, right?

It's a little known secret in the Internet service provider world that there's really only three ways for traffic to flow between Internet networks. And that really is that if you're a big Internet service provider, and you have a customer in your network that's trying to talk to another customer in your network, that's the best possible situation for you to have. Because if you're the big green ISP that I've pictured here, and you've got a customer on the left that's trying to connect your customer on the right, the customer on the left pays you, let's just say they pay you $1, the customer on the right pays you, and they also pay you a $1. At the end of the day, you've got to make the network between these two customers work, which is quite easy, really, because it's your network. And, at the end of the day, you earn $2. And that's fantastic for you. So situation, one, you bought your customer trying to speak to your customer.

But no single Internet service provider is big enough to connect the entire world together. And as you've seen in the picture earlier on, today there's about 77,000 Internet networks that make up the Internet. So, ultimately, for you to get to speak to another network, you're going to have to connect to somebody else. And the model that we know about is, we go to a transit network, and that transit network will connect us to the Internet. So, here the picture's changed slightly, we've

got our green customer on the left, that hasn't changed. And we've got a customer on the right, the red customer, and we've got two networks inbetween, with the transit network, or even many transit networks, it's really not important. What we see here is that both the red and the green networks earn money from their customers, because this is how they are staying in business. This is how they connect their customers to the Internet. But because there's no direct path between the green and the red Internet service provider, what they have to do is they have to go through a transit network. And as a feature of going through the transit network, they have to pay out money. At the end of the day, they recognize revenue from their customers, but they've got to pay the transit network. And the important part here is that the earnings that they get is that $1 that they got from the transit customers, less whatever they have to pay to the transit networks.,

So, situation two, you earn 1 minus x, which is less than two. The third possible situation we have, is where we have the same two networks, but they are both connected to the same Internet exchange, or multiple Internet exchanges, that really doesn't matter to us. And the notable difference here is that because they are peering across the Internet exchange, they're not paying each other money to exchange the traffic. In this case, each of the green and the red networks still earns the $1 that they earn from their customers, but because they're not really paying money, there's no commercial agreement between the red and the green network, they retain that dollar. Of course, they're spending some on their network, but the fundamental differenc is that they still earn $1.

So, you've got three situations. One where you earn $2, one where you earn 1 minus x, which is whatever that's going to be, and where you earn $1. Any rational network will always try to make the two, right? Let's be honest about this, people want to earn as much as they can. But because it's not practical, it's not possible for one Internet provider to connect to the entire world, what's realistically going to happen is that the rational networks are always going to seek to maximize their earnings. And in a situation where you can't earn $2, the most rational thing for you to do is to try to earn the next best thing, i.e. earn $1 and you will always try to maximize your peering.

If that's not something that you're doing now, as a network operator, it's something that you will start doing because, as I pointed out, there's really only three ways for traffic to flow across any network. We do this by means of what we call an Internet exchange point, and you're going to hear a lot more people discuss Internet exchange points.

The only thing that I really wanted to make clear is that an Internet exchange point is physical infrastructure. In the modern terms, we have either gigantic ethernet switches, or a series of ethernet switches, at Internet exchange points. And those ethernet switches, or series of switches,

bring together a whole lot of value. Some of the benefits that you see, and the panelists are going to talk a little bit more about them, I've listed here. I won't go through these because as I said, they're going to be discussed a little later in the presentation.

Where these Internet exchanges are across the world? This is a map that I pulled up this morning from the Internet exchange point directly that PCH operate. We've been doing this for, I forget, 25 plus years now. You can see that there's a really dense set of Internet exchanges in Western Europe, in the United States, and in Brazil. The rest of the world, we're still catching up, not necessarily a bad thing. Because if you take this map, and you map it on to population sectors, you'll find an Internet exchange point pretty much where there's high density population. And that's something to factor and consider when we talk about where and how we build Internet exchanges, which is going to be in the last part of this presentation.

So I'm going to pause here for a bit and I'm going to let the panelists weigh in on the first very important question, which is why do we peer?

Vahan Hovsepyan
Indeed, why do we peer, or why do we need peering in the first point? First and foremost, peering allows you to drive down your expenses and reduce your costs. It makes economic sense. It is linked with national security issues. It also ensures the right performance and it develops the economy. But anyway, why do we peer? The question that we would like to pose to you, and discuss with you. Any views on that? What's your take on why we need peering. Talant, how about yourself?

Talant Sultanov
Right. Honored to be the first one to take the floor. My name is Talant. And I'm based in Bishkek, Kyrgyzstan. I'm chair of the chapter of ISOC. And Aziz, a colleague of mine, is also online.

Vahan Hovsepyan
Actually, this is a question for the entire audience for the participants. Why do we peer? Why do we need to peer in Central Asia? Many people say that we have already established some links and direct connections. Why do we need to peer with everyone, or why do we need peering at all? What's your take on that? Are there any raised virtual hands?

Johanna Baggen
No, I've checked I haven't seen one. In any case.

Vahan Hovsepyan
Right. In that case, I guess we need to deep dive into this issue, since we don't know what the answer to the question is, if no one knows.

Yeah, Bakhrom says peering is required to bring down Internet connectivity costs and to reduce the delays. Bakhrom, would you like to take the floor and expand and follow up on that? Bakhrom is based in Tajikistan, and he is an active participant in all of our events. He is also an active participant in various industrial events.

Bakhrom Nasirjanov
Hi everyone, Bakhrom Nasirjanov is my name. Thank you for introducing me. Indeed, I'm based in Tajikistan, and I work for Megafon Tajikistan, which is a carrier in Tajikistan. As far as peering is concerned, based on my experience, I can tell you that peering is quite useful, and it becomes part and parcel of Internet connectivity between various ISP is in the same country, or among ISPs based in adjacent countries. Because those countries that could be considered to be at the edge, if they do have transit Internet traffic, for them Internet connectivity is too expensive. Therefore, if you don't have any peering agreements with other ISPs based in other countries, for the edge-based countries, it's difficult to transport traffic from point A in one country to point B in the same country, they have to go through European countries or Russia. I'm talking about Central Asian ISPs primarily.

Naturally that increases the Internet traffic costs, since they have to go to the backbone networks. In addition to that peering reduces in other ways. We border on China. But unfortunately, we have not signed a peering agreement with China. Therefore, to reach Chinese resources, we have to transit our traffic through Russia and via other Central Asian countries, sometimes we have to go via the US. But if we had a direct connection with China, we could reduce the the delay down to 50 milliseconds or even lower. Right now it's 400 to 500 milliseconds. And this is one of the huge problems that could be solved with the help of peering.

Vahan Hovsepyan
Thank you Bakhrom. Talant started saying something but I guess he ran into some technical glitches. Talant, now the floor is all yours. What's your take on that?

Talant Sultanov
Thank you so much, Vahan. I just wanted to briefly go over our experience.

A couple of years ago, we started building the IXP in the Fergana Valley. When we started building the IXP in Kyrgyzstan in the Fergana Valley, the Internet connectivity in our country was one of the most expensive ones across the world, I would say. And, to reduce the Internet connectivity costs, especially for the nationals living in the Ferganar Valley, we decided to deploy an IXP in the city of Osh. Kyrgyzstan is a specific country, because we are split geographically wise into the northern and the southern parts. We had an IXP in Bishkek, which is in the northern part. It has existed in the country for almost two decades. It was the only IXP in the country. And when we started deploying the second IXP, more IXPs started coming on stream. Right now there are quite a few of them. Most of them are private, I would not call them independent, but they are private, which is still good for developing the Internet market in the country.

During the past few years. The Internet costs went down. The quality of the Internet connectivity went up. And, thanks to RIPE NCC and ISOC, we organized a number of educational events, and we tapped on the yet untapped potential. This is it.

Vahan Hovsepyan
Thank you, Talant. Aziz, I believe you wanted to say something. Aziz Soltobaev, you the floor.

Aziz Soltobaev
Hi everyone. I'm gonna speak Russian. I also work for the Kyrgyz chapter of ISOC, and I'm responsible for developing IXPs in Kyrgyzstan. The digital sustainability is improved by IXPSs. IXPs also increase the information security, especially if IXPs are combined with a localizing international service such as DNS root servers.

And in Uzbekistan, we try to deploy SNS-IX IXP, the main objective of which is to improve the interconnectivity. A couple of root servers will come on stream shortly, and we really hope that in the near future, jointly with PCH, we will localize a couple of other services. We will team up with RIPE and K-root. Ultimately, it will increase the sustainability of Uzbekistan and Central Asia in general. In a nutshell, this is it, interconnectivity, and resilience are the two buzzwords and I guess these two boss words can describe perfectly well I experienced in the region. Thank you so much.

Vahan Hovsepyan
Thank you, Aziz. We have Talgat online. Talgat from Kazakhstan also wanted to share a couple of comments. The floor is all yours.

Talgat Nurlybayev
Hi, everyone. I work for ISOC Kazakhstan. At the previous Virtual Series event, someone from Russia mentioned that Kazakhstan officially bans IXPs. This is not really so. I haven't been able to clarify this issue yet. I went to the Ministry of Digital Development, but I'm still waiting for their answer. You were mentioning proper things, I would say. You are that an IXPs improve interconnectivity thus improving the sustainability of the Internet, they streamline and optimize the routing, and so on and so forth.

However, given the historic specifics, Kazakhstan is a hub for Central Asia, as you're well aware. Therefore, the entire traffic in Central Asia is routed through Kazakhstan. This comment is addressed to you primarily. I asked RIPE repeatedly to do a study on the traffic routing in Central Asia. Let's say, if the traffic goes from Tajikistan or Kyrgyzstan to Kazakhstan, does it go through Russia or Europe? Such a study would be quite useful. I guess everyone would be interested in seeing the outcomes. Kazakhstan is a natural hub in Central Asia. Although I guess not everyone is happy with the work done by the Kazakh Internet service providers, and they are not happy with the prices. This is especially true for our Kyrgyz counterparts. However, as far as the Central Asian IXP is concerned, I believe that it should be deployed in Kazakhstan. It's a natural decision. And the Central Asian cooperation is something that we should focus on. It would help us greatly.

Vahan Hovsepyan
Thank you so much, Talgat, for raising a very important issue, which is the legal framework and the legal regulation. So, we will definitely discuss it in greater detail at the follow up event. Regulations are important, especially in Central Asia. I'm going to give the floor to Stavros now, and Stavros will probably share his views on that. Stavros, you have the floor.

Stavros Konstantaras
Thank you very much for the invitation to this very interesting panel discussion. Among the benefits that have been already discussed and provided by the previous participants and panelists, I want to raise also the fact that IXPS, and deploying IXPs to localize traffic, also increases the robustness of the Internet. In the current Internet ecosystem, which is a little bit of madness outside, with a lot of DDoS attacks happening every minute around the globe, we can see clearly from our customers that they suffer a lot from the transit links, that they get high volumes of DDoS attacks that actually can saturate the transit links, means that they also have to sometimes take extreme measures to shut down the transit links in order to mitigate these DDoS attacks. However, if you have some peering with local ISPs, or if you peer with them via IXPs that can help you to keep some traffic, and still route traffic between customers and other members. That means that the Internet becomes more robust. So, in case you get a DDoS attack from China or

Brazil, or wherever, you can shut down your transit link and still you can communicate with other ISPs, or local banks, or other institutions, and then you can still offer some of your services, and these people will not realize anything. And we can see this also in the Europe, whereh IXPs are very important for local ISPs. They can keep the traffic local, and still offer services to end users and customers, and also in US and other places.

I would like, also, to highlight the benefits in the local communities when local ISPs do peering, and do peering via IXPs. Back 15 years, when we deployed AMS-IX in Curacao, the local community was suffering from very low quality of the Internet because all the traffic even between the local ISPs was going via Miami, and thatwas increasing a lot of the latency and the delay. The things that happened, and improved the quality of the Internet for the local community in Curacao, and that's also an example, of course, is that AMS-IX went to Curacao and deployed the local IXP instance over there. Then we invited all the local Internet providers and small network providers to start peering via AMS-IX and they started doing so. Then the traffic localized, and the latency started minimizing, and the local community started having a much higher quality of Internet. Also, we deployed Google Global Cache over there, so some caching was happening from content providers, and also increased the quality of the Internet for some services. Some studies were executed later on, and they saw how much important was those two moves to increase the quality of the Internet for the local community.

But that was just an example, of course, I'm pretty sure similar things will happen in the future, when we are going to deploy more IXPs in Central Asia, and the local communities will benefit from more robust Internet and more faster services. That's from from myself,

Vahan Hovsepyan
Nishal, the floor is yours.

Nishal Goburdhan
Thank you. So it's certain, really, that this is the Internet lifecycle from an Internet service provider's perspective, and that's usually because I speak mostly to Internet service providers, but it's really true for any network operator.

What I'd like to do is walk very quickly through how the life cycle looks like when you're not peering. This is the model that we know, we know that there is an Internet service provider network, and that Internet service provider network has customers. And to get connected to the Internet, that Internet service provider network is going to buy transit, probably from a single Internet transit provider, and usually from an Internet transit provider that is out of your country.

You're probably going to go to one of the big service providers, that's from one of the more industrialized countries. That's how we all started, right, this is how the Internet pretty much got to everywhere that we know.

What you need to see in this picture is that you're acting less and less as an Internet service provider, and you're acting more and more as a currency, or foreign exchange point, because what you're doing as an Internet service provider, is you have a signed contract, in dollars or euros or rubles or whatever it is, with an external party. You have a lot of signed contracts with customers that are inside your environment, customers that are inside your country. Those contracts are usually in your local currency, whatever your local currency is. And all that you're doing is you're aggregating customers, you're aggregating a lot of many contracts that you've signed, usually on a short term basis. yYou're converting local currency into some kind of foreign exchange service that you have to provide to some external provider.

I live in South Africa, and I can tell you that, over the past 10 years, our currency has depreciated against pretty much any large major currency significantly. So, if you live in a developing world country, you probably know the state of your currency against more developed currencies, you probably have a really good idea what's happened to the currency over a longer period of time. So, you know that continuing to pay a foreign agent, with money that you are raising in your domestic context, is not a long term solution to your problem.

Now, I realize that most of you here are probably network operators, and you're thinking - What is wrong with this guy? We came here to listen to talk about peering and Internet exchange points. But, for me, this is a fundamentally important thing. That, aside from all of the benefits, you've heard about peering and localizing content, and all the benefits you're going to hear from even the folks that haven't spoken yet, the one thing that we tend to forget very easily is that it is an extremely important mechanism for you to retain domestic currency.That's important, particularly if you're in a developing country.

The lifecycle of an Internet network is usually that you migrate from one network operator to two redundant transit providers. You do two things when this happens. The first is, obviously you get redundancy, you have the opportunity to say if circuit one to provider 1 fails, I have a separate link to circuit provider 2, and that's going to continue to give me uninterrupted service to the Internet. This is really why we buy redundancy. But, whether you realize it or not, you do another very important thing when you purchase from a redundant transit provider. What you do is you shorten the cost, or you shorten the path, that you use to get to a resource on the Internet.

So, here's a very simple explanation. Let's imagine you're the network at the bottom, the network that I've labeled You, and you've got one transit network. This is a very simple situation where you've got one path to the Internet. You're trying to get to a popular resource on the Internet, maybe a search engine, and that's network A, and maybe you're trying to get to a social networking site, and that's network B. The numbers that I've chosen at random, are just the number of hops, or the number of networks, it's the path that you take to get to those networks. 5 and 7 is 12. Because you're connecting to two sites, the average length for your users to get to the Internet is 6 in this case. I realize this is a very simple example, but it's going to make a point, I promise you.

So, two important resources that your users are trying to get to, the average length of - the number of networks, the path that your users have, is 6. When you add a second network, a second transit network, that transit network is probably buying transit from a different set of networks, it's probably peering at a different point on the Internet exchange, and so it's going to have different paths, the different costs, to get to the same set of resources. Your network now has two ways to connect to the Internet, to those resources that we were talking about, networks A and networks B. All things equal, the path that your network is usually going to take is going to be the shortest path, the cheapest path, the one that's, in the context of our example, the one with the fewest number of hops. That means you're going to pick a path that I've highlighted here. The average length of you connecting to the network is going to decrease, and that's now going to be four hops away. Again, this is a simple example but it shows you one really simple thing about the Internet. One fundamental thing that matters to your networks, users automatically because of the technologies used in the network, right, because of the technologies used in BGP that you're familiar with, that we're not going to talk about here, because of technologies used by the networks at the end, that tend to want to prefer lower latency paths. Users are going to prefer the path of the network that is cheaper, that is shorter, they're always going to choose a shorter path to get to you.

That's an important concept. Because when you get to the third part of the Internet lifecycle, the part that I like to say where you add a single Internet exchange point in your economy, that's exactly what happens. Users, content, the network is always going to prioritize a shorter path to getting to the same content that you were trying to get. before. Ideally, you want that part to be a path that is connected to the first Internet exchange point that is set up. Because if you have more content, if you have more paths available to you via the Internet exchange point, your users will use it. Contributes to, is lessening the outflow of capital from your environment.

I should have prefaced this by saying that I'm an economist, I pretend to know BGP and peering, and I pretended to know BGP and peering for 25 years. So, a lot of what I think about, when it comes about peering, is talking about doing things at national strategy level, because I see it as that way. I see it as reducing the outflow of capital from your domestic economy.

The final part that we see here, and this isn't something I want to talk too much about, is what happens when you get to a stage where your Internet service provider networks have now migrated, or evolved, or grown to a point, where you're not just carrying end users as a network, where the networks themselves, the customers of the networks themselves, other networks, you become a network service provider in the environment, you have multiple Internet exchange points connected to your city. This is the end goal.

And I think that this is the thing that I am going to ask the panel about when we get to the last part. So let's speak a little bit in detail about there. But I always like to walk through. I like simple examples, because it helps me to think about things. Let's walk through a simple concept that we think about, and one that we use every single day, but might not necessarily be obvious to you in this way. There's a concept called hot potato routing. Basically it describes how packets move between networks. The concept of a hot potato, if you're trying to hold it in your hand, is that you want to get rid of it as quickly as possible.

So, how do networks, and how does traffic move in this context of hot potato routing? Well, we've got two networks again, network red and network green, and we've got the red customer that's trying to send a packet to a green customer of the network. In a situation where there are two Internet exchanges, how does traffic flow here? Well, the red customer is trying to send traffic to the green customer. So, we're moving from left to the right of the screen, the red customer sends a packet to the red Internet service provider, its network, because the red customer is paying the Internet service provider's network for transit, for connection to the Internet. The red network has two choices, because it's connected at two Internet exchanges, that's IXPS, and it can choose to either send its traffic to Internet exchange 1 or Internet exchange 2.

There's a very simple concept that I want to perhaps sum all of this up by later. But, for now, think of it as hot potato, how do I get rid of the hot potato as quickly as I can? And what I'm going to do is, I'm going to pop that traffic off to the Internet exchange that is closest to me. So, the red network makes its decision to, say, let me push the traffic off to Internet exchange point 1. Because the red and green networks are peering with each other, the green network sees the packet, and because it does what responsible Internet service providers are meant to do, it receives a packet from exchange point 1, it backhauls it across a longer path. However long the

path is not the point. What's important here is that there's a short path and there's a long path. And the green network pulls the packet back along the long path and delivers it to its customer. So far, we've completed half of the transaction needed to support this Internet transaction. But, as you know, most transactions on the Internet are always send and receive. So, we've sent the packet, how does the return packet flow back?

Well, the return packet, we now have the green customer that's trying to speak to the red customer. So, the green customer sends his packet into the green cloud, and the green network has to make the same but reciprocal decision that the red network made just a short while ago. How do I send this packet loss? And what it does, again, simple concept, hot potato routing, it tries to get rid of the packet as quickly as possible. And it sends it -- you might think it's logical, but we're going to explain this, we're going to explore this in a second. But the green network hands a packet off to the Internet exchange point 2. This time it's the job of the red network to pull the packet across the long distance, and deliver the packet to its customer. The end of the day, the customers are communicating with each other, and the internet's working, and we're all happy.

But how does that work from a costing perspective, or here you've got two Internet service providers connected to two Internet exchanges. Both of them would have had to invest infrastructure, they would have to invest transport or transmission to get connected to the Internet exchange. They may have to have had to pay for routers that they have to install at each Internet exchange and, of course, any other necessary infrastructure, personnel, etc, etc, to build those connections. Because, in this very simple example, we can see that because both operators are connecting to an exchange that's close to them, and one that's far away from them, we have a relative sharing of costs. The red network receives money from its customer, and it uses that money to invest in infrastructure. Similarly, the green network receives money from the green customers. It uses that to fund its bills to fund its connections to the exchanges. And that's fantastic.

The short part of this is, we pretty much have symmetry, we have a fair sharing of costs between the network operators. That's my point, when I said that peering isn't really free, necessarily. You still have to pay to run and manage your network. If you're a network service provider anyway, you have to pay to run and manage your own network, you get investment from your customers, or partners, or whomever, and you use that to build your network. We like to say at PCH that the efficiency of the Internet depends on this principle, and that is, as long as there are two exchanges, and as long as each partner is connected to both Internet exchanges, and traffic is allowed to choose the path to flow across, and it flows naturally in this way, the Internet kind of works out, everything becomes nice and fair.

But, I prefer to think of the corollary here, I prefer to think about this from the perspective of what happens if there are not two Internet exchanges. And for me, the realization here is that countries, or cities, or economies that haven't yet built Internet exchange points, well, you're disadvantaging yourself, because all that you are doing if you do not have an Internet exchange point in your local context, is that you are exporting capital outside of your region. To put it in context, the little picture that we drew here, if you are the green network, and there is no Internet exchange point that is close to you, you are always going to be paying for the long distance circuit. And whether that long distance circuit is to Frankfurt, Amsterdam, London, one of the more interconnected regions of the world, you're paying the long distance cost. The networks that you're connecting to on the other end are generally going to pay the shorter costs. Always.

My challenge for you is for you to see this. This is what happens when you don't have an exchange point in your economy, you're always paying the long distance cost. How do we break out of this model? How do we break into a model where we can get the networks, that we are sharing traffic with, to connect at multiple Internet exchange points, or more importantly, connect to an exchange point where we get to pay the short part of the circuit? As a very simple equation that I'd love for you to remember, if there's nothing else you remember about this presentation. remember two things: I didn't shave, I'm sorry, and secondly, this simple equation, speed times distance equals cost. That's true when you build and develop your network.

So, if this were a real face to face meeting, I would do a quick poll with you. I would ask you, how many of your customers are interested in having less speed? Which of your customers want slower Internet services? I've asked this question all across the world, and there's only been one place -- I won't tell you where, it's in the Caribbean, though -- somebody said, We'd like our customers to have slower Internet service. But, across the world, it's generally considered that people want more. That's it, people want more. They want more speed, and they want it cheaper than what they're paying for now. So, you have two constraints in the simple equation, you've got to increase speed, but you've got to decrease cost. You don't need to be a master mathematician to realize that the only variable that you are going to have to play with that's left here is distance, which is what we were talking about. How do I reduce the distance? How do I reduce the cost that I have to pay to get to the content or to get to the networks that I need to exchange traffic?

Nishal Goburdhan
So, I'm going to hand back to Vahan and the rest of the panel. And I think these are the some of the discussion points that you're going to work through. Vahan?

Vahan Hovsepyan
I'd like to thank the interpreter for the brilliant interpretation. He even translates all the jokes. Anyway, we have a very interesting question about breaking the vicious cycle. What do we do to build a domestic or original eco system? And how do we make sure that we have a great local content? Because in the Soviet Central Asia, we primarily have content which is generated elsewhere. How do we attract global players to Central Asia? How do we minimize our connectivity costs? What's your take on that? This is a question for all of the participants.

By the way, the very first question is probably the most relevant. Do Central Asian countries have local content? Or do we go to mail.ru? Do we have any national servers that could be developed to attract additional content providers to the region?

Talant Sultanov
If I may?

Vahan Hovsepyan
Sure, go ahead.

Talant Sultanov
First and foremost, let me comment on the content. That's why I changed my background. During the COVID-19 pandemic we realized that content provision is a huge headache, especially as far as the educational content was concerned. In Kyrgyzstan, we launched the Ilimbox project, which is aimed at developing educational content in the local language because, indeed, we have training content in Russian. If you speak English, you can enjoy much educational content in English. However, Kyrgyz is a very popular language in rural areas, but there is very little educational content in Kyrgyz language.

I changed my background on purpose to follow up on the issues raised by Nishal. In his presentation he mentioned that it takes at least two IXPs to tango. Well, by way of an example, ISPs and mobile carriers do not collaborate too much here. Three mobile carriers build three data centers, or three ISP is deploy their own cables. In other words, what I'm saying is that they do not cooperate with each other, they want to build their own data centers, they want to deploy their own cables, they want to build their own mobile communications towers, they use separate power lines to power their data center, and so on and so forth. Cooperation between the national players is a logical step.

On the face of it, we have to work for the same country, but in practice, they compete with each other. We have to think about how to incentivize all the ISPs to develop a joint IXP infrastructure. That's why a lot of our villages are not covered, because in some regions, we have three towers, and in some regions, we don't have a single tower. So, this is a problem. Thank you.

Vahan Hovsepyan
Thank you, Talant. And, by the way, this is a question which is linked with the legal framework and regulations, the joint operation of telecom infrastructure and Internet infrastructure, as well as the power grids, as well as other utilities. I think that this issue is subject to different regulations in different countries. We could address this question to Nishal and all the other panelists, what's your take on that?

We will definitely raise this issue in September during the follow up event. Because, like I said, regulations is one of the core issues for the Central Asian countries. Access to the physical infrastructure is important, access to utilities is also important. And you are right on point now that, during the COVID-19 pandemic, access to both public resources such as educational resources, and governmental body's resources became of paramount importance. I know for a fact that many Central Asian countries passed laws, bylaws and regulations, obliging or recommending to the carriers to ensure access to these resources. The same holds true for the Caucasian countries and other regions.

So are there any other prerequisites to develop local networks? Oh, how do we attract foreign participants? By the way, Nishal, are you talking about networks or network carriers?

Nishal Goburdhan
I see Michuki's hand is up. And I have a very good idea that we should he is going to be answering that part of it as well.

Michuki Mwangi
Thank you, Vahan, and thank you, Nishal, for that great introduction and background.

So, I think the conversation on this should be, one of the important things to understand is the value that each network needs to bring -- will be bringing to the Internet exchange point. And that's often an understated value in terms of why the interconnection is important, or why is peering important. We've seen this, and I'm speaking from a context of having worked with Nishal for the last decade or so in Africa to build the peering and interconnection ecosystem. When people get to an Internet exchange point and connect, they expect that by miracle, something,

that the traffic will just grow. And in actual sense, that's not the case. It's understanding the role that you played, not just by building the infrastructure or connecting the fiber to the ports on the switch, but the role that you actually play as a community in first understanding how that values ecosystem works, or how that value chain works. And second, the role that you will individually play to bring this to grow that particular, or contribute to that growth. And this is something that's often really understated in a lot of the conversations that we have with stakeholders.

And so the question here is, how do we build the domestic content? So, we start by understanding what is actually local, what services already exist locally that are not available at the Internet exchange point. And we see many countries where government services are not digitized. So, what is the role that the stakeholders can play to influence government to actually digitise its services, and we've seen very impressive statistics coming from some of these markets where previously government services were not digitized. They've digitised over 200 or 300 of those services. And that makes government become a content producing network, or CDN. And that increases, not just the traffic, but the usage, because there is a demand now. As a user, I need to access government services, I no longer need to go to an office, I can access that electronically or digitally or via the Internet, and that increases demand.

Secondly, the other services like banking services, which again have traditionally been in person, but with mobile, the advancement of mobile services, etc, it means you can have all services, these banking services, available digitally. And that means that, if those services are available through the Internet exchange point, then it drives users and increases the traffic that you will find locally.

And then we go now to the enterprise market, where you have a lot of other enterprise businesses that are traditionally not seeing at the exchange point, and haven't actually digitised their services. So, getting them to digitise their services means more traffic available at the Internet exchange points by virtue of networks, and so on.

The Research and Education Network is another network that is often not connected to the Internet exchange point. In fact, some countries don't even have a Research and Education Network. So, getting this one built to serve the research and academia community, getting that connected to the Internet exchange point, brings more traffic. And the national cctld, again, connected to the Internet exchange point.

And so, you can now keep building on this. We've seen quite a lot of innovation happening around this content space. We've seen betting services, which are traditionally done using other means, and now the betting services connect to the Internet exchange point, and so on. Yes, well, that

might be controversial in some countries, but we've seen them driving quite a lot of traffic, because if you think of the last -- for those who are soccer fans who are watching the Euro 2021 matches, then you will see that draws a lot of betting behind which team will win. And that, actually, really increases the amount of traffic. Or now, as it is, watching those matches live and so on. So, getting the traditional media houses, TV stations, etc. to connect, to digitise their services and connect online, will suddenly be key to growing their networks, and also the resulting in the number of content that will be available online.

As that grows, then it leads to the next question, which is how do you attract foreign networks to participate. And this foreign networks means they're actually going to be bringing two things. One, there will be either networks as initial explained, that are actually looking to connect, they have customers in that market. So, could be end users, could be enterprise. So, they could be either content networks, or actually carrier networks that are looking to connect to that market.

And, if the policy part, of course, needs to be in place, policy and regulation needs to be in place, to make it easier for those foreign networks to actually build and connect to those markets. Because remember, they're not coming to sell services, they're just coming to peer. And we've seen countries that have actually realized the value of this, and say, Oh, well, if they're only coming to peer at the Internet exchange point, they don't need a license. So, they can come in, put their infrastructure inside a data center, and immediately start peering locally. That's a major milestone that will help attract foreign networks. Also, making sure that the Internet exchange points operator actually makes it possible for foreign networks to participate in its governance model, meaning that, Oh, can I, as someone who's interested in IXPs from Kenya participate in the governance of the Uzbekistan IXP. So, if that's the case, then that's great because it means there's a lot more visibility into what's happening in the future, what's really happening with the growth of the IXP, and as an interested party, then it means I will then be pushing my organization to come and connect to that IX.

So, there is a lot more that will need to happen at the community level of the IXP. And I think we'll talk about this a little bit more, about building that community, strengthening the community role within the exchange point ecosystem, and stakeholders, so that they can actually play a role in growing the networks and traffic at the IXP. So I'll close there for now.

Vahan Hovsepyan
Thank you so much, Michuki. We have yet another comment from Talgat on the content. However, before I pass on the floor to Talgat, I just wanted to raise another issue. We're saying that the states should allow IXPs and development. Even this phrasing means that we need to get

permission from the state authorities. But, that's just one part of the story. Another part is the governmental support. The government should ask the Internet service providers to use their local IXPs. This is especially important for Central Asia. Do you think that governmental support is important? Talgat? What's your take on that?

Talgat Nurlybayev
Good afternoon, again, ladies and gentlemen. Actually, I wanted to offer a couple of comments on the Central Asian content. It's not going to be in high demand outside of Central Asia, let's be realistic, be realists. Even such European countries as France or Germany don't even have websites or web portals that are in demand globally. I would say there are a few content providers, primarily the US, that covers the English speaking customer. China is a separate story because it's a market within itself. And I believe that, in our region, Russia is the largest content provider. By way of an example of the most popular content in Kazakhstan, we have a national singer named Erke Esmakhan, and she has over 130 million views on YouTube for Central Asia, this is quite a significant figure. And we have other pop singers Kairat Nurtas, Dimash, and they have 20 to 50 million views on their YouTube channels. So, they have several dozen million views on their YouTube channels. But, in Central Asia, we will never create anything similar to YouTube. That's just an example, to illustrate what I mean.

As for the COVID-19 pandemic, and the issues around the online or e-learning, in Kazakhstan, it was a huge problem and, I guess, this is the same situation for all the other countries. Several million kids go to schools, but then during the COVID-19 pandemic, for almost 45 days, all the high schools were shut down and they had to study from home. All the services were based in the US, all the servers were overloaded, the high schools gave up using zoom because that wasn't helpful. Teachers would just send homework via email to students, and then they use some kind of messenger to submit their homework to teachers. This situation happened just because we did not have any local servers. We did not have any video conferencing systems based on local service, and the traffic went to the backbone service.

In addition to IXPs, we need to develop local service and local content. The COVID-19 pandemic will stay with us for years to come, so I guess all these issues will remain relevant. In addition to creating IXPs, we need to create servers such as Moodle, for instance, which is a popular server among the educational communities, and they should be based in the clouds of such large carriers as Kazakh Telecom. I'm talking about Kazakhstan only. That's in addition to IXPs.

The last thing I wanted to mention, Talant, if my memory serves me right, mentioned that, in Kyrgyzstan, one of the headaches is providing Internet access to remote rural areas. This is a

problem for all the countries even including the most developed countries, but in 2020, in Kazakhstan, we completed a program called 250 Plus, which basically means that even the villages with a population of just over 250 people had to be connected by cable to the Internet -- by the fiber cable. And the mesh networks, mesh Wi Fi, were part of the program. ISOC, for some reason, did not support this program. Sorry for that. Just wanted to mention that in passing. Anyway, as far as the remote rural areas are concerned, I guess the situation in Kazakhstan is better than that in other Central Asian countries. But in a nutshell, this is it, brings me to the end of my remarks.

Vahan Hovsepyan
Thank you so much, Talgat. Before we move on to the next part, or the last part of the presentation, I just wanted to pose a question to all the panelists. And actually, I want to address this question to content providers, as well as people who communicate with content providers on a daily basis. So, I always take Facebook as an example. I was just wondering if there are any advantages for content providers if they use IXPs, compared to telecom operators? For CDNs, what is more preferable? IXPs or telecom operators? And Nishal, the floor is all yours.

VahAnd by the way, I'm sorry, for interrupting you. The reason I'm asking this question is that the providers who have a certain volume of content. Facebook and Google deploy their own CDN, and for them, it doesn't make any sense to peer with IXPs. Nishal, the floor is yours.

Nishal Goburdhan
Okay, thank you very much. I am going to politely disagree on that last point, I happen to run three exchanges in my country. But, I think let's talk about this, first of the slides, and we can come back to a discussion later.

So, 2019, the experience was that the Internet doubles in size almost every 11 months or so. Since 2020, when the Coronavirus has popped up, it's anybody's guess as to how much faster it's grown since then. And the thing that you always have to worry about, when you look at exponential growth like this, is one question, and that is how do I scale this kind of growth? The way that we generally would scale it is by saying that there are multiple elements that you have to worry about when you build and design, not just the exchange point, but the elements that fit in your ecosystem around that. You've already heard some of this come up already, we've been speaking about Internet exchange points so far. But exchange points are one critical element in this, what I call the cycle of upgrades, right? There's other important things like local loops, it's pointless to have an Internet exchange point, if network operators can't get to the Internet exchange point, if the local loop is closed, or heavily restricted. If you manage to do that, if you have high speed

fiber, but there's high speed fiber only within the confines of the metropolitan area, and you don't have any kind of national backbone, it's really not going to help you if you have an Internet exchange point.

Now, I'm not going to discuss each of these, firstly, because we're running low on time. And also because their slides are here, so you can read through the slides, and I think that the slides kind of go through the elements and explain the different things that you need, the foundational building blocks of not just the Internet exchange point, but the elements that are necessary to see the economic growth that will continue to sustain the Internet exchange point but, more importantly, the digital ecosystem that everybody's talking about building inside their countries. I'm also led to believe that a lot of these issues, which relate largely to regulation, how we should go about putting in place this kind of infrastructure, that's really only going to happen, or those discussions are going to happen in the next series of the Asia Peering Forum discussions, so I'll leave those elements for you to talk about then.

But, for now, the takeaway I'd like you to have from me is this, that fixing the exchange is not your silver bullet. It's certainly not going to be the element that's going to say, we put in the exchange point, and what's going on? Where's the growth that you promised us.? The exchange point is one part in what is otherwise a very complex -- it's complex because there are multiple moving parts, but it's really not that difficult to solve --system. Why I say that this is a virtuous cycle is because you have to think about upgrading each of the different components inside the cycle, and that upgrade cycle is usually a two year cycle. So, in a two year span, we will talk about upgrading the exchange, upgrading the local infrastructure, upgrading international submarine fiber cables and critical infrastructure, you're going to get back to the point where you're going to start all over again, it really is a continuous virtual cycle.

The complete picture looks more like this. There's a few more elements in here than just the five that I had pulled out initially. When you sit down to discuss, in your ecosystem, what are the things that we have? What are the things that we should be building on? For me, this is a good starting block for you to work on. You should be making a to do list, a checklist, that says, how do we better all of these elements, and then continuously do that again? As I said, I won't discuss this in too much detail, because this discussion is still happening at a little later on.

What I'd like to talk a little bit about right now, though, is what it takes to build and run the exchange. Because we're talking about developing Internet exchanges, we're talking about getting exchange points operational, and there's often confusion in how this should work. I pointed out, at the start, that I run three exchange points in my country, I've been helping to build and develop

Internet exchange points for many years. Michuki and I have done a lot of good work together, not just in Africa, but around the world. There are five key elements, the five key elements that I've listed here, the ones that I think are really the elements that you need to focus on and build, and that's really to consider. Again, I'm not going to discuss all of this in detail, because I know the panelists will. What is the governance structure that you want to think about for running your exchange point? Here, my guidance to you is always that a community built nonprofit Internet exchange point is almost always the best solution when you're starting to think about building an Internet exchange. Unfortunately, we're now living in a world where people think that it's okay to build an exchange for profit. I don't like that idea, and I don't like the mentality that says the exchange has to be profitable, because you shouldn't think of the exchange as something that's making money. In fact, the exchanges that I promote, the exchanges I try to get built, I usually encourage people to try to make them free from cost. Because, in my experience, what happens is that if people start to see the value of the exchange, then running into those elements that would otherwise cost you money, things like, how do I get new equipment for the exchange? Things like, how do I get technical support for the exchange? Or, how do I get dark fiber to run, you know, multiple sites, if I'm doing that? That will come from your environment. You're going to look at me and say, Nishal, you don't know what you're talking about. The world is very different right here.

But, I'm thinking of 25 years ago, when the country that I live in, when Johannesburg was a very different city, when we were asking ourselves those same questions. How do we see this growing? How do we see this being built? How are we going to get people involved? Because I want to say we got together as a community, we recognize that from our position at the bottom of the world, if we didn't try to make this work for ourselves, nobody else was going to build infrastructure here. Because, over a period of 20 years, we've developed and grown that environment, it's now I think that we are an attractive enough model for big networks from the outside, that want to now come and invest and build infrastructure and run infrastructure out of our country.

Remember what I said about the long path and the short path of the model, and it's only really been in the last few years, that we've managed to get external networks to come into South Africa. When that happens, when they build infrastructure in your country, the cost to connected them becomes the cost of getting fiber across town. Our community is now understanding that, they recognize that, and that's why when I say community nonprofit, I can say that because that's how we run our exchanges. Our community nonprofit donates time, they donate people, they even donate dark fiber, we get dark fiber at no cost. Because folks inside my country now understand that the bigger purpose of this Internet exchange point, it's not just about lowering latency. It's not just about building local content and growing local content. It's a larger economic picture. And if we can do that together, in the form of a community, nonprofit, that becomes a lot easier for

people to want to invest in. And that's why my guide to you, when I talk about governance is always to say, how do we make this work for us without thinking of how do I necessarily make money out of it?

When I think about neutrality? Of course, neutrality is bestd, you will hear fantastic stories about people saying that build carrier-neutral data centers, and a carrier-neutral data center is the best for an exchange. I think we all know that. But, the reality is that there isn't a large number of carrier-neutral data centers in all over the world, or particularly in the area that you're looking to build in. And, for me, what's more important is consensus. Consensus is more important than cost, I write here. Don't build a carrier-neutral data center if you want an Internet exchange point.

My go to story here is a country in West Africa that decided they needed an exchange, so they took a loan from the World Bank for $2 million to build a data center, so they could get an Internet exchange point. That is absolutely wrong model for you to follow. Exchanges can develop anywhere, there are really big exchanges that have started out in the broom closets of hotels. I can give you lots of examples, but we're running out of time. What's important is that people that are going to connect to the exchange, the networks that are going to connect, have consensus in that where you're trying to put something, that's the most important thing, that they are all happy with that location.

I've already spoken about the nonprofit. But for me really the part about being a nonprofit is driving down the cost to operate. We have a saying at PCH that the function of an Internet exchange is to lower the average per bit delivery cost of the network, i.e. it's got to make the network cheaper to run. If you artificially inflate the cost of running the Internet exchange point, if you start to charge people extremely high port fees, if you start to hire people simply to run the exchange, when you can have volunteers do this, then you've got to pay them salaries upfront, even if you only have 10 peers. And it's really not a lot of work to run a layer two fabric, right? If you do that you inflate the costs, the only way you're going to get the cost back is by charging port fees, and that's going to disincentivize people from connecting.

If you need equipment, there are lots of ISOC people on this call. ISOC, I believe, donate equipment, PCH donates equipment, so you can write to me. But, there shouldn't be a lot of friction to getting an exchange started once you have at least three willing participants. Don't try, again, don't try to make money from the Internet exchange.

I think the last point for me here really is this, the exchange must work to support your community. This idea that we're going to build an Internet exchange, and everybody is going to

connect to it after we build it, is completely the wrong way to think about it. The Field of Dreams approach -- Field of Dreams is a US movie, if you're familiar with it, this idea that if we build it, it will work -- doesn't work for Internet exchanges. What works for Internet exchanges is consensus within the community. This has proven itself across the world, whether you're talking about a large country that's perhaps sparsely populated, because people are all over, or you're talking about highly densely built countries, island economies as well, if you cannot get your community to have consensus that the exchange is going to work and, in the domestic context, they're going to peer at the Internet exchange, the exchange is not going to be successful, and that's the wrong approach that you want to take to investing.

So, invest in your community, right? Invest in your community, because that's the important thing. There's a line that I love to use, it's the line at the bottom of the slide, and it says that, as operators, we all compete at commercial level -- we have to because fundamentally, most of you are in this to make money, right? So, we compete, obviously, at commercial level, but we collaborate a technical level. We have to work with our competitors, even at least at a technical level, to making this work, because it's that competitive collaboration that grows the community, and that builds the Internet exchange for us to grow on.

There are a whole bunch of things that you can do at your exchange. I won't talk about this, because we've already heard people mention this already. You can run lots of anycast services, you can run validators, there's a series of services that are available for you to do. I guess the most important thing here is, really, how do I get the exchange to showcase that I have technical prowess in my country, that the community is smart, and the community is engaged. We have a competition really in my country, with the technical team, the volunteers that make up the exchange, as to who can think of interesting services that we should have at the Internet exchange, and usually the winner gets dinner, free dinner, and then we all go and treat them to a dinner. That's the kind of competitive competition that I think is useful, where you're actively thinking how do I make something work better? That's the model I would definitely recommend for you.

Things that can go wrong? I've already spoken about increasing the cost. If you don't want to increase the cost, don't look for work. Internet exchanges are fundamentally very simple things to work. They are a layer two fabric as you start. It's only when the exchange has to extend to multiple locations and have connections across the city, and you should only really start doing that when exchanges become -- well, rather, when the fiber to get from A to B becomes as close to zero as possible. I mentioned that we get fiber donated to us, if we were not in a position where we had fiber donated to us, then the cost of running darkt fiber to different buildings, the cost of

paying for colocation in all of those different buildings, would be prohibitively expensive, would not allow us to run a multi-site exchange. So, do what your community does, and our community has asked us to run a multi-site exchange, and they have enabled us to do that through things like donations from the data centers, give us free colocation, like a cabinet where you can run exchange infrastructure, the fiber operators are giving us fiber so that we can interconnect these things. When you get to that point, that's your community voting for you. It's your community telling you, we think you're doing the right thing, we want to be involved, we want to back that.

Don't try and run an old boys club. It's a common problem in a few areas of the world where they think that the exchange point is really a connection place only for Internet service providers. That was very true in probably the 90s, probably the early part of the 00s, but it's no longer the case. If a network like Facebook, or Google had to come to you and say, hey, we went to peer at your exchange, would you tell them no? Of course not. You want the content at your exchange, right? So, make the exchange inclusive, allow anybody that has a valid autonomous system number, and valid Internet resources to come to the exchange and connect to the exchange. You'll find that if you do that, people will choose whom they want to peer with, and the exchange will grow.

That's the thing that you want, you want to build that ecosystem that the rest of the world is going to look at, and say hmm, I'm going to invest there, because that's how you attract foreign networks. That's your goal here. When foreign networks get to your exchange, your cost to connect to them becomes close to zero as possible. That's the long term picture we're working towards here.

And I don't bet on one horse. This is a bit of a weird thing for me to say but, I always think of it as -- we have a saying at PCH, another saying, which is that exchanges may develop differently, but we don't pick and choose which exchange is the one that should develop. Maybe one exchange is going to run fundamentally different to another. If you can, try and support them all. Because, ultimately, it's going to be the community that really is going to decide what and how that Internet exchange needs to operate, to work, to serve that local community.

I think for me, the telling part of all of this is, if you don't decide to do this, if you don't decide to get up, and build, and grow your domestic exchanges in a manner that works for you, then only two things are going to happen, only one of two scenarios. You're going to continue to pay networks to ship your traffic overseas, and you've heard some of the problems that brings, cost, time, latency -- the example of changing traffic with the Chinese was really a good one, I thought. You've heard about the problems that brings you, right? It's an export of capital out of your economy and, obviously, that's not the situation you want to be in. The only other viable option, if

you don't decide to build and grow your domestic exchange, is that somebody else will. You're going to find probably a large exchange franchise going to come and try to deploy that in your infrastructure, or somebody who thinks that they can build a large exchange franchise. When they do it, when people that are not invested in your community decide that they want to, how should I say, gift you an Internet exchange point, they're not doing it for free, they're extracting capital from your economy, again. So, either way, you're paying. And my challenge to you is act or pay. You decide which model you want to build in.

I'm going to pause here, and I'm going to hand over to the participants, the panelists, Vahan and the rest of the team for them to discuss the issues that we've spoken about. I'm also just going to say, thank you. My name is Nishal Goburdhan, my email address is on the screen if you'd like to contact me. I'd love to reach out to some of you and hopefully be back in the region when the world turns to normal, I hope. Take care and thank you.

Vahan Hovsepyan
Thank you so much, Nishal, for a very interesting presentation. Thank you for giving us the step by step instructions on what to do, or how to do, and what not to do.

The last but not least question pertains to the elements that are missing in the local ecosystems. What do we do to ensure that we have good peering and great IXPs? How do you identify these missing elements? And what do we do to deal with those challenges? By the way, another important question is what IXP model is best suited for a startup environment? Actually I will cross out startup, and I will just say what IXP model is best suited for your countries. Is it a NPO model, a commercial model, or a hybrid model? What do you think? Let me see if there are any raised virtual hands. By the way, Aziz and Talant, you tried to use this model in Kyrgyzstan, if I'm not mistaken. Go ahead, Talant.

Talant Sultanov
in Kyrgyzstan, we used the open, non-commercial, nonprofit ISP, and all the interested parties concerned can connect to this IXP. Of course, we're going to have to look into the sustainability model. We'd like to thank ISOC for supporting the construction of, the building of this global IXP. I liked what Nishal stated, that we need to build consensus first, and then build the IXP. Unfortunately, in our case, it was not really in that order.

Let me address Nishal's earlier question whether people want cheaper or slower Internet connectivity. Nishal, let me share the following anecdote with you. In Kyrgyzstan, we have the cheapest mobile Internet connectivity, we're only the second best to Israel, according to the

official statistics. But, on the other hand, it's one of the slowest Internet connections in the world. So, in our case, we choose to prefer the cheapest but the slowest Internet connection. Thank you so much.

Vahan Hovsepyan
Aigerim, and then Stavros. Aigerim Abakirova, you have the floor.

Aigerim Abakirova
Hi, everyone. My name is Aigerim Abakirova, and I work for the community of carriers. Just for your information our association has built a an IXP that can operate in both modes, namely both on a commercial basis, and on a nonprofit basis. The nonprofit access is provided to members of our association, while the commercial basis is offered to any other stakeholders who are willing to hook up to our IXP. By the way, our IXP is one of the largest in Kyrgyzstan and, as far as I know, there are no other IXPs of such a scale.

Our IXP is of a local nature, and to make sure that we get access to the global backbone networks, last year as part of the [unintelligible] partnership program, we pushed the following idea partnership with Deutsche-IX. The main reason for that was that in Central Asia, each country has its own IXP. That holds for Kazakhstan, Russia, and Kyrgyzstan. We started thinking, how come we don't have a regional ISP that would bring together our national? And, actually, we already offered two options to Deutsche IXP. The first one would be for them to build their own IXP in one of the CAS member states, and we will all use them, or establish a joint IXP in Kyrgyzstan, and [inaudible] IXP would become a regional IXP. This idea was put on the back burner, because our authorities are still discussing these two options. In a nutshell, this is it.

Vahan Hovsepyan
Thank you so much, Aigerim. Before I pass on the floor to Stavros, let me follow up with another question. The two options that you described, do they include CDNs?

Aigerim Abakirova
This is a question for the tech savvy guys, I'm a lawyer by background. I'm not aware of that. I just described the situation as far as the regulations are concerned.

Vahan Hovsepyan
Michuki also raised his hand. So, you will have the floor after Stavros. Stavros, you have the floor, and then Michuki, you will have the floor.

Stavros Konstantaras
Thank you very much. Going back to your previous question, and coming back from AMS-IX, which is a nonprofit organization, I believe this model of nonprofit and neutral IXP is great, especially for economies that are currently growing, and IXPs that are still in the very beginning of their life. That model is great because, as history said, people will collaborate to solve some technical issues, they work together to fix a lot of problems that they will exist initially. As Nishal said in his presentation, with this great slide with the circle, it's not only the IXP that has to be fixed, let's say, it's just one part, and is a very simple part to fix. There are other things that need to be fixed as well. Colocation is one, fiber connectivity is another one. And, of course, also the base with the governance model and the regulations. So, all these parts need to be fixed. And this part when they're going to fix, they're going to grow the IXP as well.

So, when people collaborate in a non-for-profit model, in a community based model, they talk together, they try to solve the issues together. In the same time they can push towards the government, or other parties, altogether in order to bring their ideas into life. Coming back to AMS-IX history, that happened when AMS-IX started up many years back, 25 years back, actually, when people had to solve a simple technical problem, which was to share the same transatlantic link that connects Europe and Netherlands with the United States. There was only one and the problem that we're trying to fix was to -- how we share this common resource among us, and this is how AMS-IX started, because people want to collaborate in an efficient way to serve these resources. Then, later on, they worked together into growing up the IXP. I believe this model is great. I don't say that the commercial model is bad. Of course, it also has its own benefits. But, history says that, okay, when people work in a collaborative and neutral way, the benefits are much larger for a wide variation of the community as well. That was my comment in the previous discussion and question.

Michuki Mwangi
Thank you Vahan, for the opportunity. I just want to comment on something that has been mentioned by the speaker before Stavros, and this is with respect to the issue of regional IXPS, or thinking that you can interconnect IXPS. It is something that has come up in our region more than once, maybe even a couple of times, and it has never been successful, and it is less likely to be successful for a number of reasons.

First and foremost, let me start by stating that, when we talk about Internet exchange points, there is not definitional understanding of a regional IXP. In fact there is nowhere where you'll find an IXP stating itself to be regional. This is because an IXP is there to serve networks that are operating in a particular market, and you can have multiple IXPs in the same market. We've seen

cities which have multiple independently operated IXPs in the same city, in the same metropolitan area, and so on. Part of that is because an IXP is serving the interests of its community. So, it's not a national IXP. No, it's an Internet exchange point. So, when people start referring to IXPs as national, regional, global, etc, then that creates a certain level of misunderstanding, especially on the policymakers and regulatory side of things, because that tries to insinuate that also you can have a local IXP, which is connected to a regional IXP, which is connected to the global IXP. But that's not exactly how that works, because the way it works is that operator's networks connect at the Internet exchange point, and Internet exchange points don't interconnect with each other. Because then that will be going into the business of the operators. And that, as Nishal mentioned, is that they will be now competing with the services of their members, and that will mean members will then run away or disconnect from the exchange point because it's now a competitor, rather than an enabler or facilitator for them to get, you know, lower cost of access.

So that's really an important note thing to note. It is certainly a question that pops up many times. You should not be surprised when it does. But we have had a lot of lessons and discussions with policymakers with respect to this issue. We're happy to talk to you maybe bilaterally, or on other sessions, on why this is really important for you to raise up the understanding, with the policymakers and regulators, of how exchange points work, and why we don't interconnect them, and why the need really is for you to help support the establishment of Internet exchange points to support the market where the demand is, in other words, where there are more than three operators that are willing to interconnect and there's consensus around that. Thank you.

Vahan Hovsepyan
That's a very interesting point of view. Thank you, Michuki, for sharing that. Aigerim wants to take the floor.

Aigerim Abakirova
I have a question for Michuki. He mentioned that right now there is no such a thing as a regional IXP. I do understand that, it's just a definition that we use. For instance, let's take Euro-IX, isn't it a regional IXP?

Vahan Hovsepyan
From the get go, be sure the answer is no.

Aigerim Abakirova
Judging by the name, It's regional.

Vahan Hovsepyan
No, it's not. It's an association. Euro-IX, isn't it a regional iXP, that is the question.

Michuki Mwangi
So, I've seen Bijal here, and probably would like to see her, because she comes from Euro-IX, can talk about that. But maybe, just as she does, there are regional associations that bring together exchange point operators, and provide them with a platform where they can exchange and discuss and learn from each other. In Africa, these are Af-IX, there's AP-IX in Asia, there is LAC-IX in Latin America. I will invite Bijal to talk about the work that Euro-IX does so that there's better clarity on that.

Bijal Sanghani
Yes. Thank you for the question. Just to confirm that Euro-IX is a membership based Association for Internet exchange points. We're not an Internet exchange point. We've never been an Internet exchange point. The idea is that, like Michuki said, we're just a membership association. We have currently 71 members, and we come together and work together to share information, learn. I hope that answers the question.

Vahan Hovsepyan
Yes, thank you so much. Now it's clear. Since I'm quite familiar with the Euro-IX. Let me add a few words to that. Euro-IX is not a virtual association, it does provide multiple opportunities to IXPs to develop further. It assists IXPs in finding partners. For instance, ARM-IX, an Armenian IXP received some hardware from Euro-IX. AMS-IX donated some hardware to us as well. There are governance or management systems, like IXP Manager, would be a good example of things that Euro-IX is engaged in, and it also helps startup IXPs. Euro-IX is a down to earth practical platform that can help the Central Asian region a lot in building a good IXP model for it to take off.

I wanted to pose yet another question to all of the participants, which is as follows: what issues would you like to discuss at follow up events, because the reason we organize the series is for you to be able to discuss relevant issues for your regional IXPs, or for the XPS that you want to develop in the region, for them to be more sustainable, more robust. If you have any specific requests, I understand that you might have multiple questions about the legal framework, the regulations, we will discuss it at the next event. However, if you want to raise additional issues, or if you want us to invite certain speakers or partners, just let us know. The next event will take place in September, just let us know in the chat box, or just raise your hand and state it orally. In addition to the regulations and the legal framework, what other issues would you like to discuss during the September event? Anything at all?

Mavzuna Abdurakhmanova
Vahan, hi.

Vahan Hovsepyan
Mavzuna, hi.

Mavzuna Abdurakhmanova
Hi, it's great to be able to hear you. First and foremost, I'd like to thank you for organizing the series of events attended by experts from our countries. You're well aware of the fact that we've been discussing this issue for quite a number of years, but thanks to the COVID- 19 pandemic, the Internet boomed in our countries. In the mega cities, broadband access has skyrocketed, and it's the providers that initiated building an IXP. One of the questions is as follows. Initially, we want to involve startups, young guys who want to take the lead, and the very first question is, are there organizations or institutions that can help us with some technical resources, administrative support, governance and management skills. I believe that for countries that already have IXPs, it might not be relevant, but for our countries, initially, some sort of support would be important. So, I was just wondering if there are any institutions like that?

Vahan Hovsepyan
I think Mavzuna is based in Tajikistan. I guess the essence of the question is, Tajikistan does not have its own IXP, if any of the panelists are ready take this question now? At the last event, we discussed a very similar thing. Max, would you like to comment on that?

Let me take that. I know that, time and again, that PCH provides, donates hardware as well. Nishal is writing things in the chat box. PCH would be happy to assist, you can email Nishal directly, he'll assist you on that. ISOC also donates hardware, and it's not just network hardware. We can also provide the auxiliary hardware such as solar panels, air conditioning units. The Euro-IX participants can also provide some sort of assistance. The very first router that we received was the one sent by AMS-IX. I'd like to thank both AMS-IX and the Euro-IX for donating to us servers and network hardware, but the local community also assisted us a lot. To get something from Europe or the US, first and foremost, it takes time. And to build a small scale IXP you need to get some hardware from the local carriers as well. RIPE NCC currently runs a program. Back then we did not have a program like that, but now it's the projects fund.

The main message is that if there is a will, there is a way, and you will definitely get assistance both from the global and the local stakeholders and players. If you decide to build an IXP then all the

counterparts including RIPE NCC, ISOC, PCH, and other partners will come to the rescue. Trust me on that. You can turn to any of us and we'll be more than happy to assist you. And if we're unable to do that our partners will. Well thanks you so much. bijal@euro-ix.net. If you have any questions pertaining to assistance, turn to one of the counterparts.

I'd like to thank all of the participants. I'd like to thank all the panelists, and I'd like to thank our sponsors for enabling us to organize a series of events. I'd like to thank Facebook, FLEXOPTICS, AMS-IX, and I'd like to thank in RIPE NCC.

Hisham, thank you so much for organizing this event, and Nishal, thank you for delivering the presentation. I would like to thank the interpreter for the translation and for a sense of humor. Thank you so much.

If you have any other questions, you can email all of your questions to any of our panelists. Thank you so much. I'll see you in September at the next event in our series, you will get invitations in advance. Thank you so much.